

Growth Of High-Quality AlN on Diamond Using Ti Buffer Layer

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Keywords: MPECVD, UNCD, AlN, buffer layer ,

Abstract

A high performance piezoelectric film, such as Aluminum nitride (AlN), combined with high acoustic wave velocity substrate, such as diamond, is a promising for applications as high frequency SAW devices. However, the growth of high quality AlN on diamond is a great challenge. The diamonds by microwave plasma enhanced chemical vapor deposition (MPECVD) technique usually possess faceted grains with very rough surface, which is not suitable for growing the piezoelectric AlN thin films. Polishing the diamond films is extremely difficult due to their hardness. Diamond films with smoother surface are thus urgently needed. In this work, we first grow diamond films using CH₄/Ar plasma to result in a diamond film with very small grain size (< 10 nm), the ultra-nano-crystalline films (UNCD). Then we grow high quality AlN thin films on UNCD, using Ti-buffer layer (10 nm to 200 nm) for enhancing the adhesion of the AlN on UNCD. By tuning the Ti-buffer layer and AlN deposition parameters, c-axis oriented AlN with a thickness of 1 μm were obtained by reactive RF-sputtering technique. The column structured AlN grains were grown, with c-axis oriented almost perpendicular to the diamond surface. AFM showed the average surface roughness (Ra) was less than 20 nm. The AlN/Ti/UNCD materials show good potential for SAW device applications.

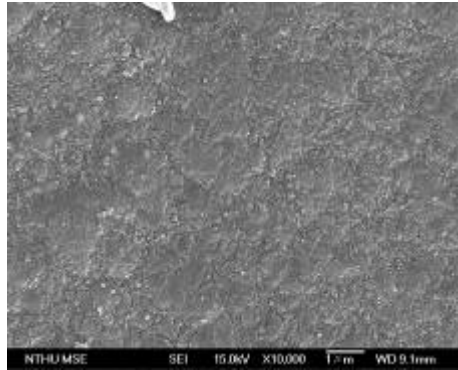


Figure 1. Diamond surface after polishing by diamond polishing paper.

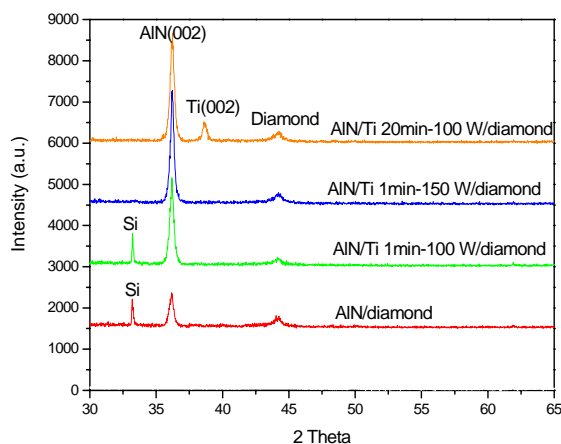


Figure 2. XRD of AlN on diamond and different Ti buffer layer.

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